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Insects traversing grass-like vertical compliant beams CHEN LI, RONALD FEARING, ROBERT FULL, University of California, Berkeley — Small running animals encounter many challenging terrains. These terrains can be filled with 3D, multi-component obstacles. Here, we study cockroaches (*Blaberus discoidalis*) moving through grass-like vertical compliant beams during escape. We created an apparatus to control and vary geometric parameters and mechanical properties of model grass including height, width, thickness, lateral and fore-aft spacings, angle, number of layers, stiffness, and damping. We observed a suite of novel locomotor behaviors not previously described on simpler 2D ground. When model grass height was $>2 \times$ body length and lateral spacing was $<0.5 \times$ body width, the animal primarily (probability $P = 50\%$) rolled its body onto its side to rapidly (time $t = 2.1$ s) maneuver through the gaps between model grass. We developed a simple energy minimization model, and found that body roll reduces the energy barriers that the animal must overcome during traversal. We hypothesized that the animal's ellipsoidal body shape facilitated traversal. To test our hypothesis, we modified body shape by adding either a rectangular or an oval plate onto its dorsal surface, and found that P dropped by an order of magnitude and t more than doubled. Upon removal of either plate, both P and t recovered. Locomotor kinematics and geometry effectively coupled to terrain properties enables negotiation of 3D, multi-component obstacles, and provides inspiration for small robots to navigate such terrain with minimal sensing and control.

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